Space Weather Technical Forecast

Issued on Thursday, 18 August 2022 at 12:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/G2 Minor/Moderate geomagnetic storm, Day 1 or Day 2. Further Moderate flares (R1-R2 Radio blackouts) likely throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Moderate with four M-class flare observed in the past 24 hours. The largest of which, an M2.0 at 17/1345 UTC, was from AR3078 (Dkc/Beta-Gamma-Delta) in the southwest quadrant. There are currently four numbered sunspot regions and two small un-numbered on the visible disc at present. AR3078 in the southwest quadrant remains the largest and most active region, displaying some strong spots, and still with a delta configuration, though there is evidence this maybe weakening a little. AR3081, now in the northwest quadrant, is the next largest region and has been responsible for several C-class flares. AR3082 and AR3083 have both shown some weakening in recent hours. The remaining (un-numbered) regions are very small simple spot regions.
A CME associated with one or more flares in short-succession from AR3078 on the 16th has been analysed and may give a glancing blow to Earth early on day 2 (19th Aug), though the bulk of the ejecta appears to pass below Earth. M1 and M2 flares from AR3078 and a filament lift off to the west, on the UTC afternoon of the 17th produced a combination of two notable CMEs, which are modelled to mainly pass below Earth. However, there may still be some possible glancing influence from these later on day 2 (19th Aug).

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, increased gradually but rather erratically from 450 km/s to between 550 and 600 km/s. Density was initially at average or below average levels, but soon rose above average levels, peak 22 ppcc near 17/1700 UTC before settling around 11ppcc. The IMF was at Moderate levels in the range 10-18nT. The north-south component was Moderate ranging between +15 nT/-17 nT. The phi angle has largely been negative (towards the sun), with a temporary switch to positive (away from the sun) around 17/1800 UTC. Parameters are indicative of an enhancement from a likely CME arrival around 17/1600 UTC. Resultant Geomagnetic activity was Unsettled (Kp 3), with a G1-G2/Minor-Moderate Storm (Kp 5-6) observed between 17/1500-2400 UTC, as recorded by BGS.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) was High, with a peak of 4.6e3 pfu at 17/1645 UTC. However, flux levels have now dropped to Moderate then Background following the CME arrival. The 24-hour integrated electron fluence was above the Active threshold until 18/0300 UTC with a declining trend still evident. Observed fluence value of 1.20e8 integrated pfu at 18/0001 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Moderate with a slight chance of High levels. The most likely source region for any larger flares would be from AR3078 in the southwest quadrant.

Solar Wind / Geomagnetic Activity: Solar winds are currently at elevated levels due to ongoing CME influence from the 14th and 15th August CME arrival, and probable high speed stream influence from coronal hole 14. The combined effect of one or more CMEs that left the sun on the 16th August may give a glancing blow at Earth either late on the 18th (Day 1) or early on 19th August (Day 2). Also, the CMEs observed on 17th may give some glancing influence later on 19th, perhaps into early 20th, although this is low confidence. Therefore, solar winds are expected to remain enhanced through much of the period with the HSS and also with the possibility of further CME influences through Day 2, perhaps into Day 3 (20th Aug). Wind speeds should then begin to decline into Day 4 (21st Aug).
Corresponding geomagnetic activity is expected to be Unsettled to Active, with a chance of G1/Minor Storm or G2/Moderate Storms. A risk of further G1/Minor Storms carries through Day 2 (19th), perhaps into early Day 3 (20th), before reducing more confidently into Day 4 (21st).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, although with a slight chance of an S1 or greater event mainly due to AR3078.
High energy electron flux will start will start the period at Background to Moderate levels, with ongoing CME and HSS effects Day 1 through Day 2 (18-19th) likely to suppress flux levels. A rise is possible once again on Day 3 (20th), but this is low confidence. Electron fluence values probably below Active levels through the period, although uncertainty over the magnitude of any further CME influences gives low confidence...

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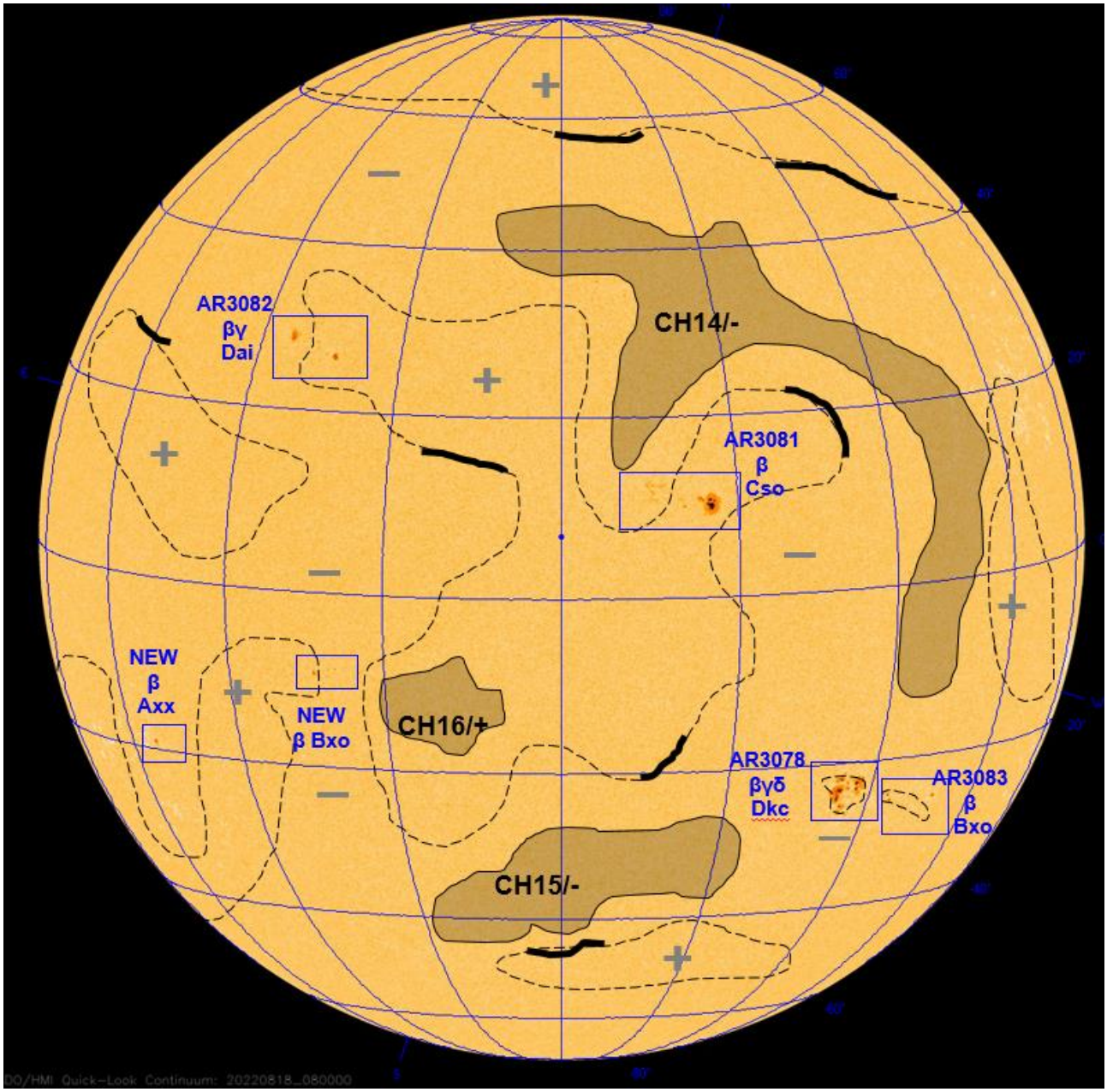
Figure 1. Solar Analysis Valid 18/0800 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are currently at elevated levels due to ongoing CME influence from the 14th and 15th August CME arrival, and probable high speed stream influence from coronal hole 14. The combined effect of one or more CMEs that left the sun on the 16th August may give a glancing blow at Earth either late on the 18th (Day 1) or early on 19th August (Day 2), although the bulk of the ejecta is likely to pass below Earth. Also, the CMEs observed on 17th may give some glancing influence later on 19th, perhaps into early 20th (Day 3), although this is low confidence and most of the ejecta is again modelled to pass below the Sun-Earth line. Therefore, solar winds are expected to remain enhanced through much of the period with the HSS and also with the possibility of further CME influences through Day 2, perhaps into Day 3. Wind speeds should then begin to decline into Day 4 (21st Aug).
Corresponding geomagnetic activity is expected to be Unsettled to Active, with a chance of G1/Minor Storm or G2/Moderate Storms. A risk of further G1/Minor Storms carries through Day 2 (19th), perhaps into early Day 3 (20th), before reducing more confidently into Day 4 (21st).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	50	40	20	5
Strong	G3	No	10	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0740 UTC	Partial Halo	AR3078	South centre disk	600 km/s	19/0001UTC +/- 12 hours	Glancing blow possible
17/1430 UTC	Partial	AR3078	SE	970 km/s	19/2100 UTC +/- 12 hours	Glancing blow possible

Figure 2: MOSWOC Enlil shows a possible glancing CME blow around 19/0001 UTC.

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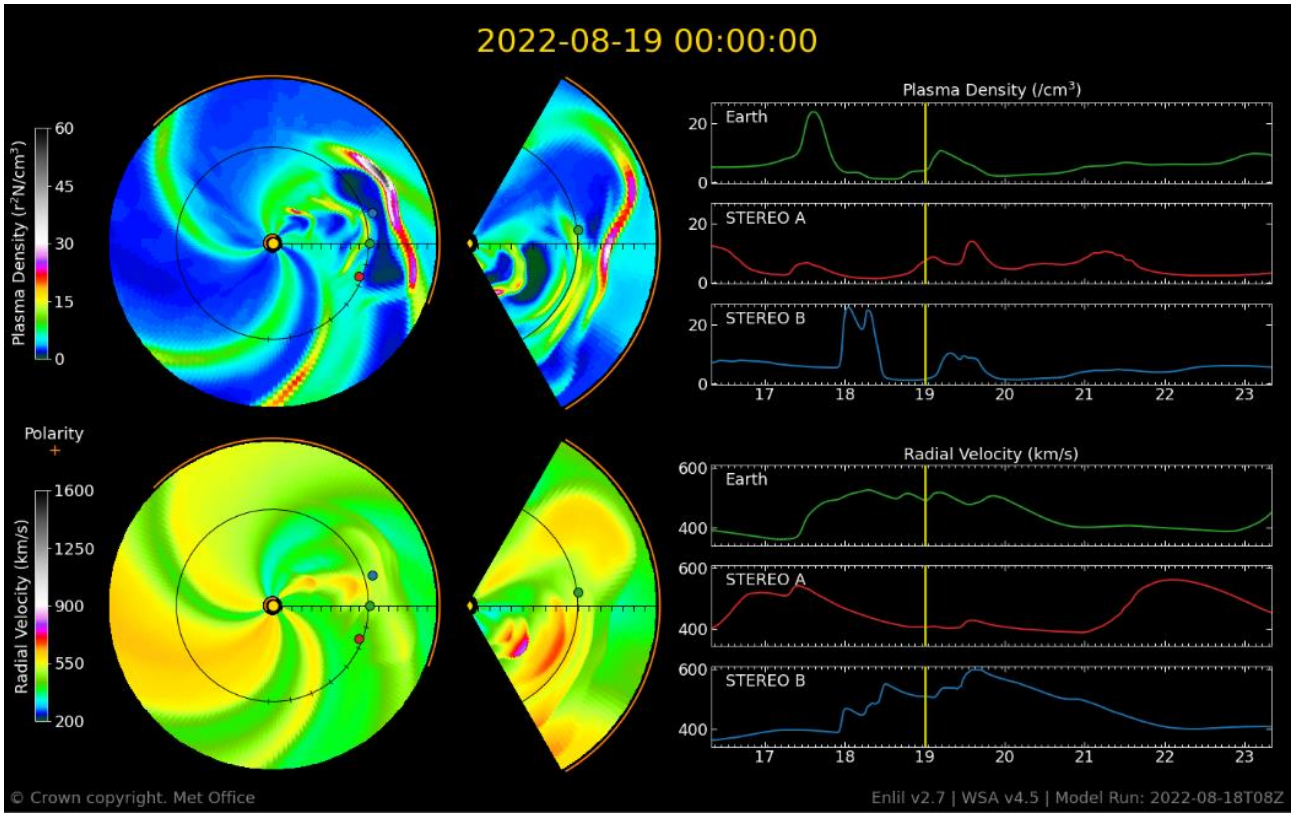
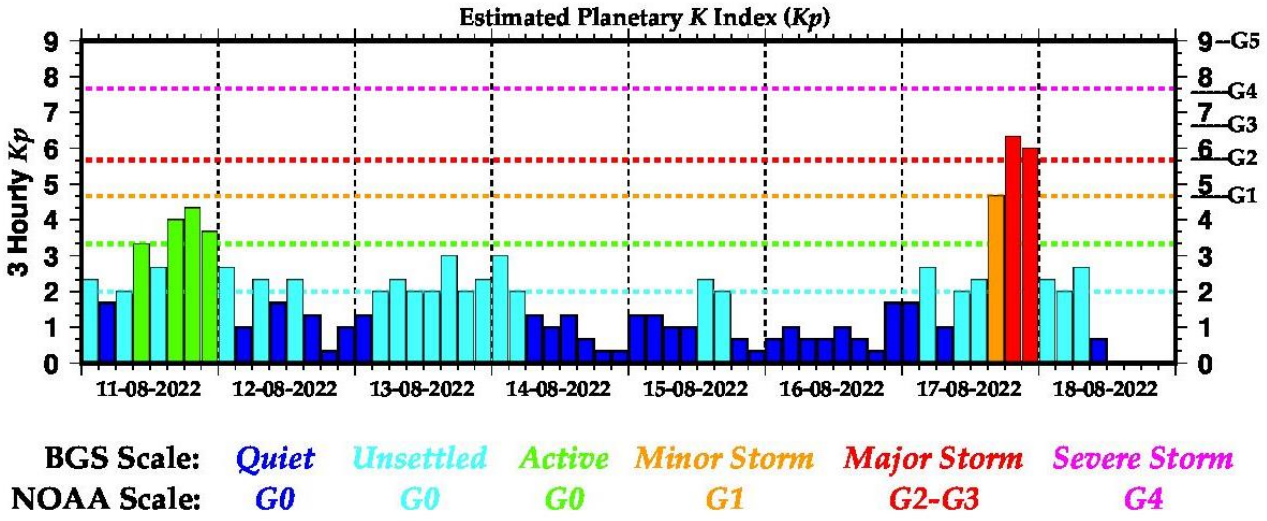


Figure 3: BGS Estimated Planetary Kp shows the geomagnetic storms between 18/1500-2359 UTC.



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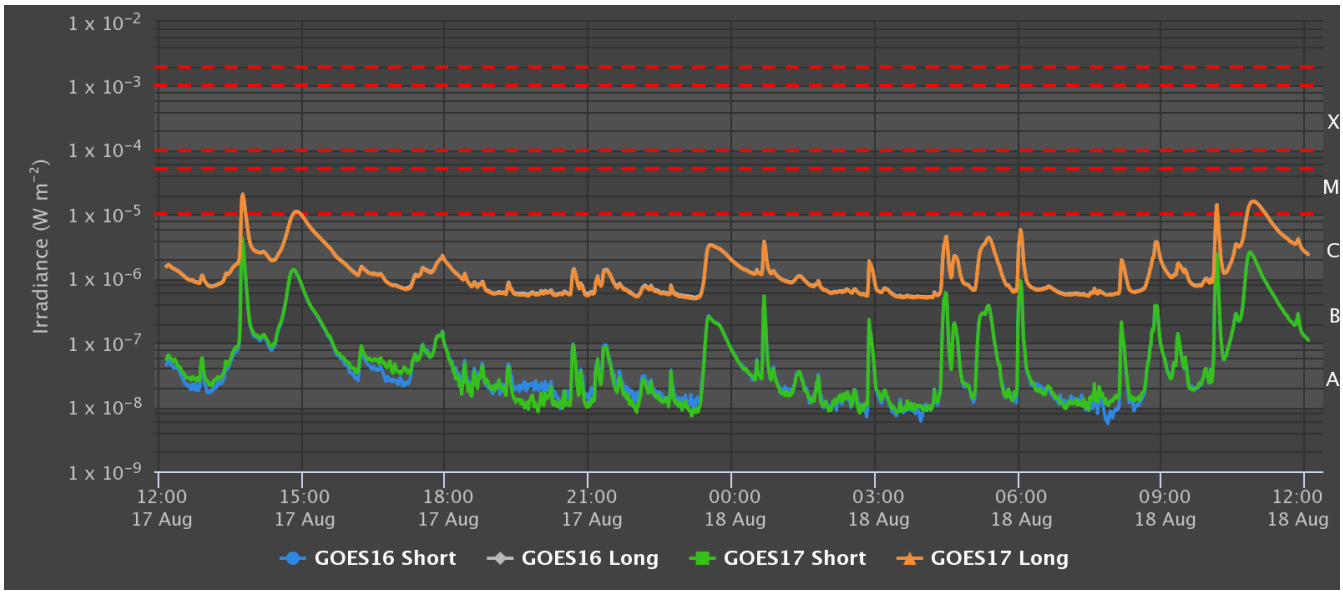
Radio Blackouts - X-Ray Flares:

Solar activity is currently Moderate, mainly due to activity from AR3078 (Dkc/Beta-Gamma-Delta). Activity is likely to remain Moderate, with a slight chance of becoming High over the coming days. Other regions of interest include AR3082 (Dao/Beta-Gamma) in the northeast quadrant, as well as AR3083 (Dro/Beta) in the southwest and AR3081 (Cso/Beta) now in the northwest quadrant. However, these areas have significantly less magnetic complexity than AR3078 and as such have a lower flare risk. Other regions appear to be stable or in decay. There is a slight reduction in flare probabilities into Day 4 as a two of the current sunspot regions are expected to have rotated over the sun's western limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 4: GOES 16 X-Ray flares shows four weak M-class (R1 radio blackout) flares.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is likely to remain at this level through the period. AR3078 carries the main, albeit slight, risk of proton events and as it transits further westward, the risk increases very slightly through the period. There is a very small contribution to the risk from AR3079 and AR3081.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) will start the period at Background to Moderate levels. During Day 1 (18th) ongoing high speed stream and CME influence is expected to suppress flux levels due to both geomagnetic effects and deformation of the van Allen belt. A further potential CME arrival later Day 1 or early Day 2 (18-19th) may continue the suppressed flux levels, with further possible glancing CME effects through the 19th into early Day 3 (20th). A rise is possible during Day 3 (20th) as geomagnetic activity begins to subside, but confidence is low by this time.

Electron fluence values have dropped sharply with the ongoing HSS and CME influences, to well below Active levels. They are most likely to stay below during Days 1 and 2, perhaps with a rise later on Day 3, although this is low confidence. REFM forecast values are currently too low, and this model won't be taking account of the CME effects. Therefore REFM trends should not be relied upon through this period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	10	20	30	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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